

Knowledge Management for Distributed Scientific Project Teams

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Managing the information generated during the course of a scientific investigation is both a challenging and an essential task for NASA scientists. During an investigation, experimental records must be kept up-to-date and made accessible to all members of a scientific team. After an investigation, a thorough set of records is essential for historical documentation, reproducibility, and overall scientific credibility. These information-management requirements are particularly challenging when scientific work is carried out by large, geographically distributed teams, but even for small, colocated teams or individual scientists, knowledge management has become a time-consuming, frustrating exercise. Ames researchers are developing a suite of sophisticated information-sharing tools to address these complex knowledge-management issues.

The *ScienceOrganizer* tool provides a centralized project information resource that is accessible to an entire scientific team over the World Wide Web. In the field or in the laboratory, *ScienceOrganizer* serves as a collection point for data, notes, records, and images generated by project participants and the scientific instruments they operate. Users can upload project information from local computers directly into the *ScienceOrganizer* repository using Internet protocols. By using a shared Web repository, the distributed team has immediate access to the most recent project information without the coordination overhead of exchanging information via File Transfer Protocol (FTP), e-mail, fax, or other more conventional means. After project completion, the repository serves as a durable archive and preserves the scientific record for future investigators. *ScienceOrganizer* features a "threaded" information repository that maintains explicit links capturing semantic relationships among stored information resources. Threading enables users to locate, track, and organize interrelated pieces of scientific data.

Today, a variety of different media and instruments are used to record scientific data, which may be collected and stored at remote locations. Organizing and accessing this information can be a logistical nightmare involving the coordination and integration of handwritten notes, e-mail, text documents, and a jumble of multiformatted data files and images generated by scientific software and instruments.

ScienceOrganizer enables users to work with this variety of source data by combining key elements present in numerous different types of knowledge-management systems. These elements include *document-sharing systems*, which provide Web interfaces to upload or download documents stored on a central file server; *electronic notebooks*, which attempt to replace paper scientific and engineering recordbooks with semistructured digital notebooks containing bitmap or digital versions of notes, sketches, images, etc.; *laboratory information-management systems* (LIMS), which are database systems that store information about laboratory samples, including the results of analytical chemistry tests performed by hand or by automated means; and *personal information-management systems* (PIMS), which organize and store personal contacts, appointments, notes, e-mail, and records for PC or personal digital assistant (PDA) users.

As an adjunct to *ScienceOrganizer*, initial standalone versions of two auxiliary tools have been developed: the *Shared Image Annotator* and the *Remote Instrument Controller*. The *Shared Image Annotator* allows multiple distributed users to simultaneously annotate and view image files stored in the repository. This tool can be used to facilitate real-time scientific consultations over the Web. The *Remote Instrument Controller* permits users to remotely control and monitor a scientific instrument, and acquire sensor data for direct storage into the *ScienceOrganizer* repository.

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